Digital Transformation and Higher Education:
A Survey on the Digital Competencies of Learners
to Develop Higher Education Teaching

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ABSTRACT

The aim of this paper is to clarify the effects of digital transformation on educational institutions and to outline the challenges that arise and need to be addressed in this context. Teaching and learning processes should be continuously developed due to changes in educational requirements as well as social and technological changes. Therefore, within this paper, these technological changes are described in the first step. In the next step, the challenges facing higher education institutions, as a result of digital transformation are discussed, and strategies for the further development of higher education, regarding digital transformation, are described. In this context, a research study that focuses on the self-assessment of the digital competencies of students is outlined and the results are presented. The first results emphasize the need for further development in technology-supported teaching and learning processes at higher education institutions. The implementation of technology-supported teaching and learning settings and the rethinking of present teaching content is seen as both a challenge and an opportunity for preparing students – as well as lecturers – for digital transformation. With regard to the current COVID-19 situation, this is a challenge that must be met sooner rather than later.

Keywords: Digitalization – Digital Transformation – Digital Competencies – Higher Education Teaching – Teaching and Learning Processes

Introduction

Digitalization and digital transformation have become an integral part of labor policy, social and scientific debates, as well as contributing to the change of learning processes of individuals and organizations. Keywords such as Internet of Things (Mukhopadhyay, 2014), disruption (Bower & Christensen, 1995), digital natives (Prensky, 2001), digital competencies (European Commission, 2019),

deep learning (Buduma & Locasio, 2017), Industry 4.0 (Dastbaz & Cochran, 2019) and finally all terms with the addition 4.0 are discussed in the context of digitalization (Heuermann, Engel & Lucke, 2018). It becomes apparent that the topic is attributed great importance in current research projects[1]. Disruptive forces and prognosticated drastic effects on society and work also illustrate the high request for scientific research and discussion about potential future changes due to the digital transformation. These changes, triggered by digitalization, lead to the demand for research in both the business and the educational sectors. In order to close these research gaps, it is important to clarify frequently used technical terms, get an overview of current and future changes in social, educational and business fields, but also point out how students change. That means it is essential to show which competencies learners bring with them today and which competencies should be developed in order to cope with digital transformation.

However, in order to promote the necessary competencies and to stimulate the development of learners, an appropriate learning environment, as well as a proper interplay of content, methods and media, is required (Handke, 2017). For didactic design, it is therefore important to know the entry requirements of learners. With regard to digital transformation, educational institutions are thus confronted with new challenges in the context of didactic designs. Hence, it seems likely that educational institutions will have to redesign their teaching and learning processes. For designing higher education teaching it is therefore crucial to determine which competencies learners develop during their school career and with which competence portfolio graduates enter the tertiary education system. In short, it is important to get an impression of the digital competencies of learners in order to develop study programs based upon them. Therefore, this article addresses the following research question: *On the basis of which digital entry requirements of students can higher education institutions further develop study programs in order to support students in their competence development and prepare them for the digital transformation?*
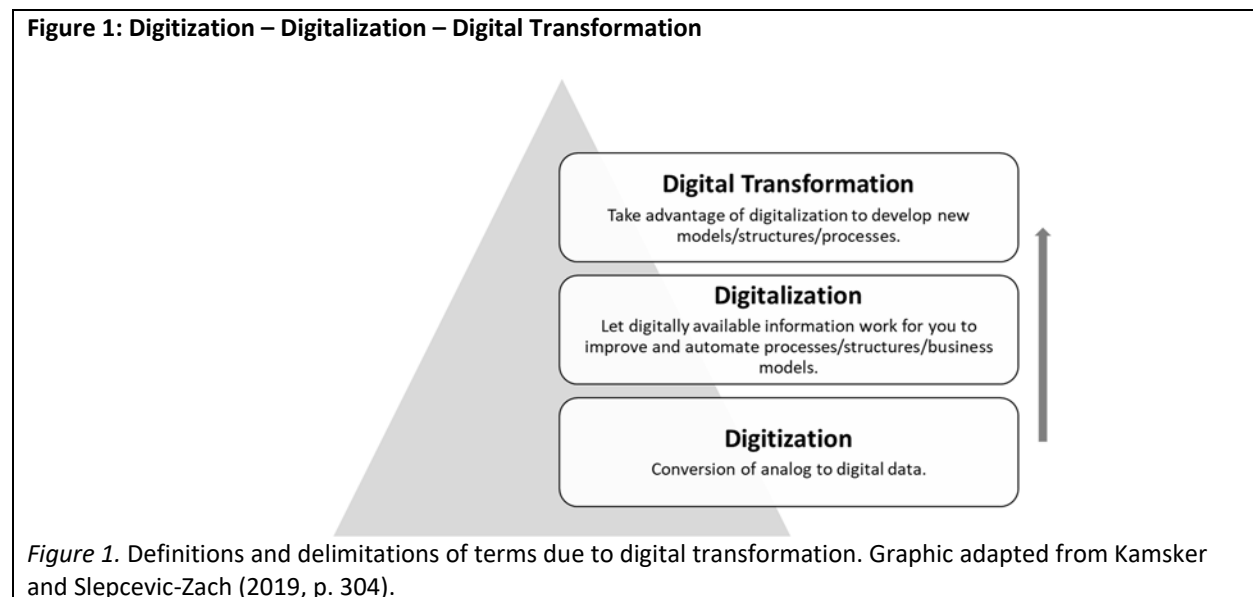
In order to answer the research question, the authors first outline the differences between digitalization and digital transformation to create a uniform basis for subsequent statements and discussion. The effects of digital change on educational institutions and organizations will be discussed explicitly, although it should be emphasized that it is not the aim of this paper to predict future developments. The intention is rather to link theory and empiricism by giving an overview of a research project currently conducted at the University of Graz. This project focuses on the self-assessment of the digital competencies of first-semester students, for in order to adapt the teaching, it is essential to know the entry requirements of students. Within this paper, the authors present results from the study's pretest with learners from secondary level education. With the help of the empirical results presented, a connection to the theory can be made and from this, the importance of adapting teaching and learning processes, in consideration of digital transformation, is emphasized.

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[1] Against the background of the current COVID-19 pandemic, it is very likely that research on digitization in the education sector will further increase in relevance and quantity in the near future. However, this article was written prior to the current developments around COVID-19, but it fits seamlessly into the necessary research on how to deal with the accelerated process of digital transformation in higher education.

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Digitalization and Digital Transformation: A Clarification of Terms

The term digitalization is based on the adjective digital, which derives from the Latin word *digitus* and means categorized, integer, countable and discrete in value and time. The origin of the term digitization goes back a long time and is attributed to the development of the binary number system in the 17th century (Vogelsang, 2010). Digitalization today describes a process of the conversion and integration of analog into digital data with at least two characteristics (0 and 1), that are located in a discrete system (Heuermann, Engel & Lucke, 2018). Analog data (that means stepless and continuous data) are converted into digital data (that means stepped and discrete information streams), whereby the information content remains unchanged (Huppertz, 2018; Talin, 2018). This also happens with processes and workflows. The transformation from analog to digital work steps, based on data represented in bits and bytes, is also called digitalization (Ensinger, Fischer, Früh, Halstenbach & Hüsing, 2016). In contrast, digital transformation refers to a more sophisticated process of thinking and structuring. Problems can be solved in new, creative ways by using existing technologies and available digital information. Due to the requirement to grow with digital technologies, the goal of digital transformation is to realign technology and business models, to come up with fundamental changes in basic structures and to adapt existing processes. In the context of digital transformation, this means that it is not the technology, but a resulting problem that is seen as the starting point, and this problem is to be solved in the best way possible through new patterns of thought (Oxford College of Marketing, n.d.; Talin, 2018).

In detail, three terms are distinguished with an even more concrete differentiation. A distinction is made between the terms *digitization*, *digitalization* and *digital transformation,* which build on each other. The level digital transformation is located at the end of the precondition chain and can be reached only if previous levels have been achieved. Figure 1 shows the delimitation and definitions of the terms related to digital transformation, as discussed by Kamsker and Slepcevic-Zach (2019).

Figure 1: Digitization – Digitalization – Digital Transformation

Digital Transformation
Take advantage of digitalization to develop new models/structures/processes.

Digitalization
Let digitally available information work for you to improve and automate processes/structures/business models.

Digitization
Conversion of analog to digital data.

Figure 1. Definitions and delimitations of terms due to digital transformation. Graphic adapted from Kamsker and Slepcevic-Zach (2019, p. 304).

Digitization is defined as a transformation of analog data into digital data. This means, for example, scanning a hand-written document and making it available digitally. When the information is available in digital form, it is used within the framework of *digitalization* to enable new workflows and to improve established ones. As an example, the electronic execution of the tax returns can be mentioned. In the past, this process was characterized by folders full of invoices, the completion of a demanding form and the storage of numerous sheets of paper. Then the tax return was processed directly to the tax office in the central tax department, where the forms were checked manually. Through digitization, it is now possible to accelerate the process and to work in a paperless manner. Taxpayers can enter their data online at any time and from anywhere, and after the input confirmation, the online form is automatically forwarded to the responsible tax office. There the data entries can be checked promptly, and a confirmation e-mail can be sent automatically to the taxpayer. This example shows that there is enormous potential for applications to facilitate standard procedures as soon as data is digitally available. These improved applications and procedures can then be used to consider changes in business activities and models. This makes it possible to exploit the potential of digital technologies. Such a process of developing new business models that integrate all digitized data and applications as well as workflows is called *digital transformation.* To this end, the example of Netflix, which has replaced the previous dominant video rental company Blockbuster, can be mentioned. In the beginning, films were available in digital formats and movies were watched at the cinema or on DVDs in the home for entertainment. Due to advancing technology and the associated digitalization that has arisen, a completely new business model emerged – film streaming (Heuermann, Engel & Lucke, 2018).

Due to the different approaches of various disciplines, such as sociology, computer science, cognitive science and business administration, the terms are used inconsistently. Nevertheless, it is necessary to establish a common understanding in order to discuss the challenges triggered by digital transformation.

Digital Transformation and the Impact on Educational Institutions

In discussions about the digital transformation of work and society (Autor, Levy & Murnane, 2003; Bonin, Gregory & Zierahn, 2015; Frey & Osborne, 2013), the structural interdependencies between technology, organizational forms, and work processes are often the focus; whereas, the people who participate in such processes, are often pushed to the background of the discussion. Although the importance of performance indicators is central, it is not the sole objective of digital transformation (Kamsker & Slepcevic-Zach, 2019; Kamsker & Slepcevic-Zach, 2020). Actually, it is more about asking questions such as, what skills do employees need and how can educational institutions create opportunities to prepare future generations for both new and different skill requirements and a changing labor market (Ahrens & Gessler, 2017).

To be a specialist in one subject or one area will no longer be enough, rather multiple qualifications are required (Schrack, 2018). There is an increasing demand for the development of interdisciplinary and personal competencies. In addition to interdisciplinary cooperation, the development of innovation and team spirit is required. In general, the acquisition of a wide competence repertoire should be fostered. In addition to the increase in professional competencies, the focus of teaching processes should primarily be on interdisciplinary (for example, communication and problem-solving skills, as well as process understanding) and personal competencies (for example, linguistic and intercultural

competencies). The demands for a wide range of competencies have existed for a long time, but due to discussion about digital transformation, the value of some competencies – especially digital competencies – has increased, while at the same time the focus is no longer on knowledge skills only (Euler, 2017; Schrack, 2018). To the same extent that the terms digitization and digital transformation are used differently, digital competencies are also associated with different definitions.

In order to name the competency facets that are relevant for the use of modern information and communication technologies, a variety of terms have developed in scientific discourse that go beyond the term digital competencies. Nevertheless, in order to be able to define digital competencies, it is important to understand the concept of competence in educational science (Klafki, 2007; Roth, 1971; Weinert, 2001). Although discussed and defined in different ways, the key aspects of competencies are the following: (1) competencies manifest themselves in concrete situations; (2) they are activated depending on the situation; (3) they are subject-bound; and (4) they are changeable (Kaufhold, 2006). In addition, competencies represent a mixture of knowledge, skills, as well as motivational and volitional aspects and are necessary in order to actively participate in society. In the age of digital transformation, an active participation includes the acquaintance of digital competencies; therefore, digital competence frameworks have emerged. One of them is the *Digital Competence Framework for Citizens* (short: DigComp) of the European Union (Carretero, Vuorikari & Punie, 2017). The DigComp Model is based upon the digital competence definition used in the publication of key competencies for lifelong learning. The latest definition is the following:

> Digital competence involves the confident, critical and responsible use of, and engagement with, digital technologies for learning, at work, and for participation in society. It includes information and data literacy, communication and collaboration, media literacy, digital content creation (including programming), safety (including digital well-being and competences related to cybersecurity), intellectual property related questions, problem solving and critical thinking. (European Commission, 2019, p. 10)

While digital competencies are defined as quoted above, competencies themselves are understood as a "combination of knowledge, skills and attitudes" (European Commission, 2019, p. 5). This includes the key elements of the educational science concept of competence. Hence, by referring to the DigComp definition of digital competencies, a connection is established between a theory-based definition of competence and a more empirically oriented one.

Transferring this definition to higher education institutions highlights the importance of covering the need for further development in higher education teaching and learning processes. Kerres (2016) has dealt with the question of the consequences of digital transformation for education. He defines the digitalization of education as a transformation of the entire learning process, from knowledge generation to knowledge communication. The definition includes a broad understanding of the learning process and in addition, preparation and follow-up activities (e.g. counselling of learners, assessment, enrollment for educational opportunities). Above all, the question of *how* the quality of learning processes has to be addressed in order to fulfill current and future requirements of the labor market and society. There is also a need to talk about the change of learning through the use of new digital technologies, as learners and their learning habits have also changed (Androsch, Gadner & Graschopf,

2017; Hochschulforum Digitalisierung, 2018). The ability to retrieve information anytime and anywhere from mobile devices, to search for interests, and to generate knowledge, refers to a design of learner-specific teaching and learning arrangements. The creation of individualized learning settings becomes more important. Learners want more freedom to design their own learning processes; nevertheless, it is important to ensure a combination of the face-to-face interaction of a classical classroom teaching setting with online units (Sachs, Meier & McSorley, 2016).

Higher Education Teaching and Learning Surrounded by Digital Transformation

Digital media, electronic platforms, as well as teaching and learning arrangements framed by information and communication technologies, have arrived in higher education and are accompanying lecturers and students in their everyday life. As mentioned, there are many changes in learning behavior and in the skills needed in an age characterized by digital transformation. In many cases, higher education institutions are merely seen as the suppliers to the employment system; nevertheless, it is important to address the demands of prevailing and increasing digitalization as an occasion for the transformation of current educational processes (Gerholz, 2018).

LeBlanc (2018) describes three challenges that higher education institutions will have to deal with in the future: (1) Development of a learning-eco-system; (2) Adaptation of the predominant unit model; and (3) Rethinking educational content:

(1) "A coherent learning eco-system in which learners move in and out over a lifetime" (LeBlanc, 2018, p. 23) is required. The system is intended to provide learners with the opportunity to participate in different learning settings offered by various institutions and thus to gain various learning experiences. A stronger outcome-orientation at higher education institutions can also be observed. The educational processes are oriented towards the needs of the employment system in a national as well as an international perspective. In that way, the focus should not only be on the labor market. It is also important to prepare students for future social, professional and private problems through the development of scientifically based action competence (Gerholz, 2018).

(2) As a further challenge, higher education institutions see themselves confronted with the need to move away from the idea of a "one size fits all model of education" (LeBlanc, 2018, p. 25) and to adapt and realign the predominant standard model in order to offer learning opportunities adapted to the future needs of students.

(3) The last aspect refers to the rethinking of previous educational content. For example, the increasing rationalization and substitution of work activities requires a rethinking of future occupational profiles. It is demanded that a new taxonomy of work activities will be created in order to deduce which tasks will be taken over by machines in the future, which activities will take place in the interaction between humans and machines, and which activities can only be done by humans. This results in new requirements and challenges for future graduates, both in society and in the labor market, which triggers higher education institutions to rethink educational content, stimulates the process of developing digital competencies and improves the quality of teaching (Gilch et al., 2019; LeBlanc, 2018).

Due to these new challenges and the expectations posed by digitalization, it is no longer sufficient to make working materials available online or to meet digital transformation solely at a level of methodical and media innovations (Hochschulforum Digitalisierung, 2016). The aim of higher education development is, among other things, to consider the employment prospects of future graduates and to adapt existing curricula (Walkenhorst, 2017) and further develop them in a cyclical process (Plan Do Check Act) in order to ultimately support students in their competence development. However, this can only be achieved if appropriate teaching-learning-arrangements, adapted to the current situation, are designed within the curricular framework.

In order to realize these demands on the further development of higher education institutions, to move away, in particular, from a "one size fits all model of education" (LeBlanc, 2018, p. 25) and to better align teaching-learning-arrangements with a focus on the future needs of students, it is necessary to start with an analysis of the people involved in the teaching-learning-process. On the one hand, it is necessary to ascertain and promote the competencies of lecturers with regard to digital teaching-learning-settings ("teaching prerequisites") (Riedl, 2004). On the other hand, in the sense of a holistic design of university teaching, consideration must be given to the entry requirements of the learners. Hence, lectures are required to design teaching methods in such a way that students are supported in their competence development (Meyer, 2015) and prepared for future challenges in their professional field (Bologna Declaration, 1999).

Under the assumption that students as so-called digital natives (Prensky, 2001) already have sufficient digital competencies to successfully complete their studies, scientific research has primarily dealt with the acquisition and development of the digital competencies of lecturers (Bundesministerium für Wissenschaft, Forschung und Wirtschaft [BMWFW], 2017; Hochschulforum Digitalisierung, 2016; LeBlanc, 2018). As digital natives, it is assumed that students possess crucial digital skills which they have learned in everyday life through the use of digital devices and applications; however, practical experience from technology-supported academic teaching suggests that students (and above all, first-semester students) cannot directly transfer their digital skills to their study situation (Kopp, Gröblinger & Adams, 2019). Furthermore, the digital competencies of freshmen appear to be very heterogeneous, depending on previous schooling, private interests and social environment. This has an impact on student's acceptance of the technology-supported courses and learning opportunities offered by higher education institutions.

In order to successfully enrich academic teaching with digital elements, it is necessary to understand which digital competencies first-year students possess in order to balance the different levels of professional competence in the field of digital transformation, and prepare students for a professional world where digital skills are necessary. Although an essential basis for teaching students with the help of modern technological tools and media-enhanced didactic methods, a well-founded survey of these digital competencies is not yet available in Austria; however, similar research studies dealing with digital competencies of students exist in Germany (Plasa, Kmiotek-Meier, Ebert & Schmatz 2019) and Switzerland (Frischherz, MacKevett & Schwarz 2018).

DiKoS: Analysis and Development of the Digital Competencies of Students

The circumstances and problems outlined above have been the incentive for a research project focusing on the digital competencies of first-semester students. The project *DiKoS – Analysis and Development of Digital Competencies of Students (*DIKOS: Digitale Kompetenzen von Studierenden, n.d.) is a joint project of all nine Styrian higher education institutions[2]. The project is dedicated to a comprehensive self-assessment of the digital competencies of first-semester students and their demands on modern technology-supported academic teaching, followed by the formulation of practical implications for academic teaching. These recommendations are consequently used for designing future technology-supported teaching and learning settings, which match the existing competencies of the students and their expectations.

Research Design and Method

The DiKoS-project aims at a complete survey of all first-semester students who started their studies in the winter semester 2019/2020 in the Styrian higher education area. In order to achieve the objective of a full survey, we decided to conduct a large-scale written survey. Prior to the study, the advantages and disadvantages of online and paper-pencil questionnaire surveys were discussed. In order to achieve the goal of a complete survey, the researchers decided to administer a paper-pencil questionnaire survey, since the response rates for online surveys are lower than those of traditional paper-pencil surveys (Gusy & Marcus, 2012; Maurer & Jandura, 2009). The chosen method of a questionnaire survey in paper-pencil format is thus in line with research interest and provides the empirical results to answer the research question. The researchers developed a questionnaire based on the Austrian DigComp 2.2 AT competence model (Bundesministerium für Digitalisierung und Wirtschaftsstandort [BMDW], 2018). This model consists of the six competence areas (0) Basics and access, (1) Information and data literacy, (2) Communication and collaboration, (3) Digital content creation, (4) Safety, and (5) Problem solving and further learning (BMDW, 2018), which are based upon the above-mentioned European Digital Competence Framework 2.1 (Carretero, Vuorikari & Punie, 2017). To get an overview of the state of research and for the operationalization process of the mentioned DigComp 2.2 AT areas of competencies, existing studies dealing with digital competencies, digital literacy, media literacy, media competencies, or information and communication technologies, have been systematically reviewed. We analyzed eight German studies in detail, which have been published in the last five years (Janschitz et al. 2019). As a result of the analysis, the researchers identified 390 items that have already been used in questionnaires. These items served as a starting point for the questionnaire. With regard to the research study – the measuring of the self-assessment of the digital competencies of first-semester students – some items from the surveys were used, while others were adapted or replaced by newly created ones.

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[2] The nine Styrian higher education institutions consist of five universities (Graz University of Technology, Medical University of Graz, Montanuniversitaet Leoben, University of Graz and University of Music and Performing Arts Graz), two universities of applied sciences (CAMPUS 02 University of Applied Sciences and JOANNEUM University of Applied Sciences) and two teacher training universities (Private University College of Teacher Education Diocese Graz-Seckau and University College of Teacher Education Styria). These institutions cooperate in the Styrian University Conference. For further information about the Science Space Styria and the Styrian University Conference see: http://www.steirischerhochschulraum.at/en/.

It is important to emphasize that when measuring competencies of any kind, attention has to be paid to the fact that competencies, per se, can only be measured in terms of performance, i.e. in action. Such performance cannot be demonstrated in a questionnaire; therefore, the questionnaire asked students to self-assess their digital competencies. However, in order to not only measure digital competencies in terms of self-assessment, other aspects were also taken into account. In addition, the term "digital competencies" is a multidimensional construct which requires more than one dimension of measurement. Such constructs must be made empirically measurable by operationalization procedures. Through the theoretical reference to the DigComp 2.2 AT model, which was used as guidance, different facets of the construct of digital competencies are reflected in the questionnaire. Thus, in addition to questions on the self-assessment of digital competencies, the questionnaire contains questions on the use and application of digital devices and online offerings, questions on attitudes towards digitization, and knowledge questions on specific digital topics.

In addition to the DigComp 2.2 AT model, the researchers also oriented towards the Digital Index (Initiative D21, 2018; Initiative D21, 2019) which has been used to survey the digital competencies of German society, annually, since 2013, using a multidimensional Digitization Index. The DigComp 2.2 AT Model and the Digital Index have been the frames of reference for the creation of the study questionnaire, due to a well-founded presentation of digital competence understanding. The first draft of the study questionnaire was constructed with these two reference points in mind and prepared for pretesting.

Description of the Population and Pretest Sample

As previously mentioned, the researchers aim for a complete survey among first-semester students in the Styrian higher education area. According to official figures from the nine Styrian higher education institutions, in the winter semester 2019/2020, a total of 5,866 students received a matriculation number for the first time in Austria. Of these 5,866 first-year students, 4,676 could be questioned, which corresponds to a response rate of 79.7%. In order to successfully conduct a survey on such a large scale, a pretest with the measuring instrument used is required. Hence, the pretest was conducted to test the validity of the questionnaire and to check whether the planned multivariate analysis methods would be feasible in practice. In this paper, the researchers specifically focused on the results of the pretest as the data from the main survey was not available at the time of publication.

The pretest was conducted with upper secondary education pupils and not with university students. This can be explained by the fact that, due to the project schedule, the researchers could not wait to pretest students at the semester opening in October 2019. The researchers decided to question potential prospective students, meaning pupils in their last school year in the upper secondary educational level. The focus schools included schools with an upper secondary diploma (Matura), specifically in Academic Secondary Schools Upper Cycle (AHS Oberstufe) and Colleges for Higher Vocational Education (BHS) like Secondary College of Business Administration (HAK), Secondary School for Economic Professions (HLW) or Higher Federal Technical College (HTL). Because of Matura examinations, pupils in their last year quit school earlier. For this reason, the pretest was conducted with a sample of pupils in the third (AHS) and respectively the fourth (BHS) class of the upper secondary level. A major limitation of the pretest itself is the questioning of *possible* first-semester students and not first-semester students themselves.

Nevertheless, the surveyed sample is as comparable to first-semester students as possible and best represents their attitudes, behavior and style of living.

The pretest took place in eight different schools in Styria. Overall, 176 pupils completed the questionnaire. Due to listwise case deletion the number of cases used for statistical analysis differs among the presented calculations. In our sample, 63% attend a BHS and 37% an AHS. This is in contrast to the educational background of Austrian first-semester students who predominantly come from an AHS. According to the Austrian National Education Report 2018 55% of first-semester students attended an AHS before beginning their studies, while only 35% attended a BHS (Mayrhofer et al., 2019). Furthermore, the majority (72%) of our respondents are female and have grown up in a rural environment (59%). The average age of the pupils is 18 years.

Results

Starting point: The Role of Digital Devices and Media in Everyday Life

Digital devices and tools determine the everyday life of young people intensively. For example, the majority (79%) of the respondents state that they use digital tools, such as an online calendar or notes app, to organize their daily lives. 80% also agree that the disappearance of the Internet and digital equipment would have a negative impact on their lives. More than half of the people surveyed (54%) indicate that a life without the internet would be unimaginable.

On the one hand, this means there is a strong dependency on digital devices and the Internet. On the other hand, there is also an awareness of the consumption of online media and a critical reflection on its intensive usage on the part of the pupils. More than half (53%) strongly agree that they often use the Internet longer than they intended. Furthermore, 76% want to be consciously "offline" more often in the future. Concerning the future, more than half (53%) are worried by the idea that much can be done only via the Internet. Another interesting finding, highlighting the insecurities towards a digital future, is the fact that pupils do not feel well-prepared for digital transformation: More than two thirds (70%) point out that school has not prepared them well for a digital future.

The strong dependency paired with critical reservations towards digital devices and digital media, lead to an ambivalent relationship between the pupils and their digital environment. This relationship can be described as follows: Digital devices and digital media are both a blessing and a curse at the same time and have – as well as a blessing and a curse – a huge impact on pupils' everyday lives.
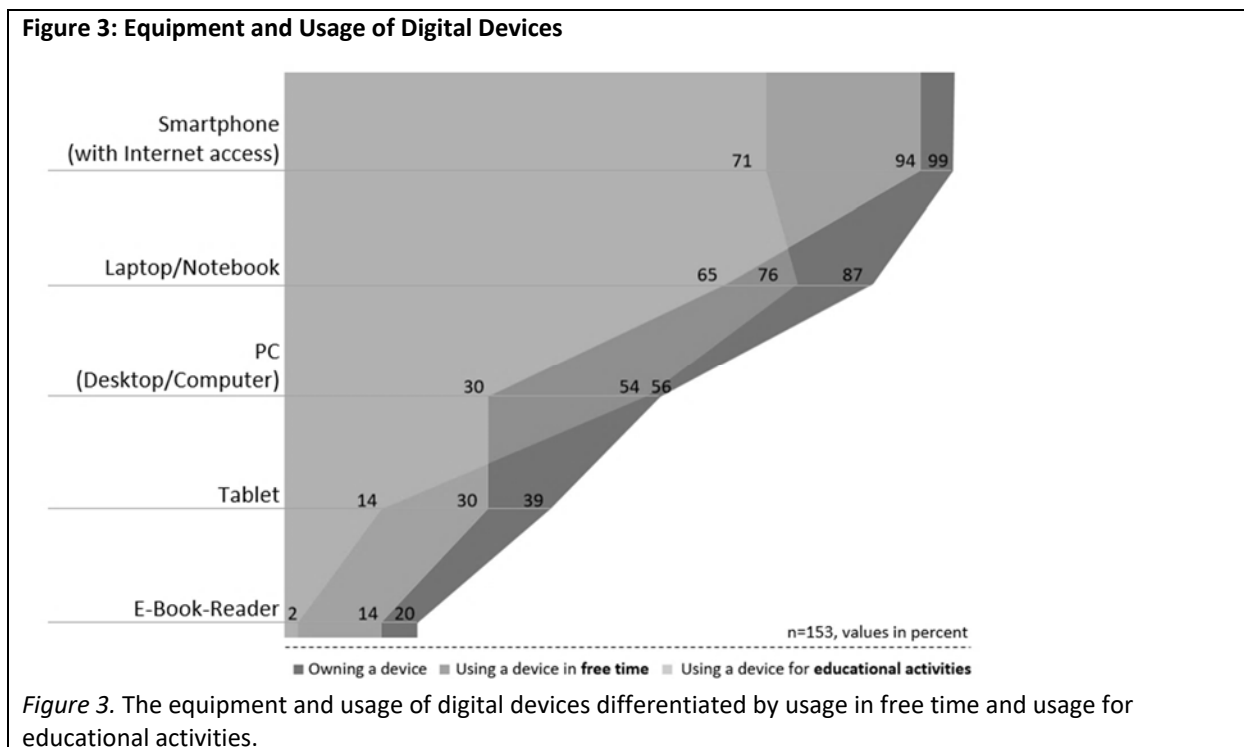
Figure 2 shows a list of the items discussed above. These items address the attitude of the pupils towards the Internet and digitalization. They have been measured on a 4-point Likert scale, where number 1 stands for "strongly agree" and number 4 for "strongly disagree". In the Figure 2 the items are sorted by mean, whereby low mean values indicate approval.

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Figure 2: Attitude towards the Internet and Digitalization

n=131, mean values: 1=strongly agree, 4=strongly disagree

Figure 2. Items measuring the attitude towards the Internet and digitalization sorted by mean values.
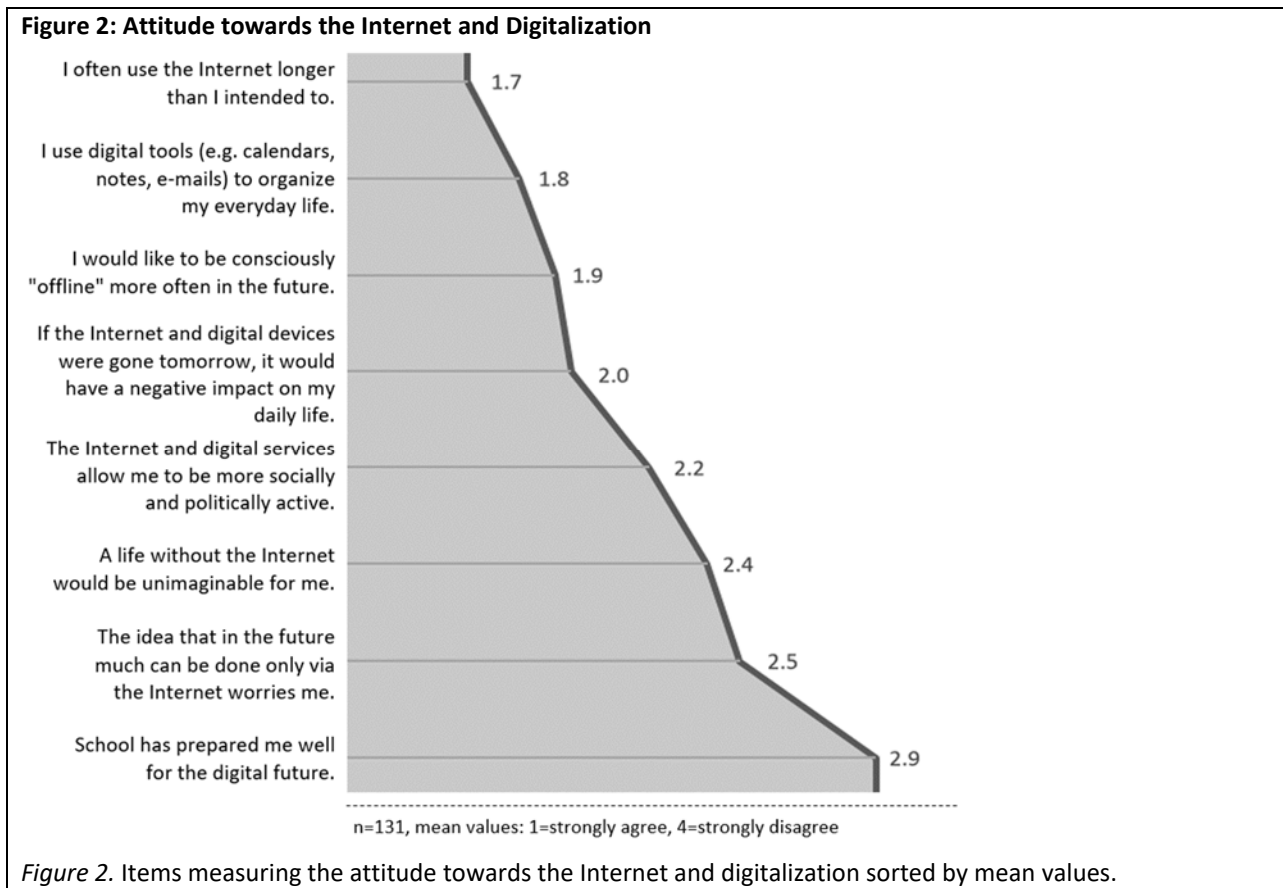
Hidden Potentials: Equipment and Possible Benefits in Higher Education

On average, each of the participants owns 3.4 devices, of which almost everyone owns a smartphone (99%), by far the most popular device among the respondents. As can be seen in Figure 3, 94% use a smart phone in their free time, while only 71% use their smartphone for educational activities. Therefore, the potential for higher education institutions and the professional use of smartphones in future technology-supported teaching and learning settings is enormous, as about one-third of those who own a smartphone do not use it for learning contexts.

The same applies to the use of tablets as well as e-book-readers. Both devices could be utilized in educational institutions, as well, since less than half of those who own a tablet (39%) use it for school purposes (14%). An e-book-reader is owned by 20%, while only 2% use it for educational activities; however, it is interesting to note that laptops or notebooks and desktop PCs are generally used more frequently for school activities (laptop/notebook 54%, desktop PC 76%) and less in leisure time (laptop/notebook 30%, desktop PC 65%).

Figure 3: Equipment and Usage of Digital Devices

Figure 3. The equipment and usage of digital devices differentiated by usage in free time and usage for educational activities.
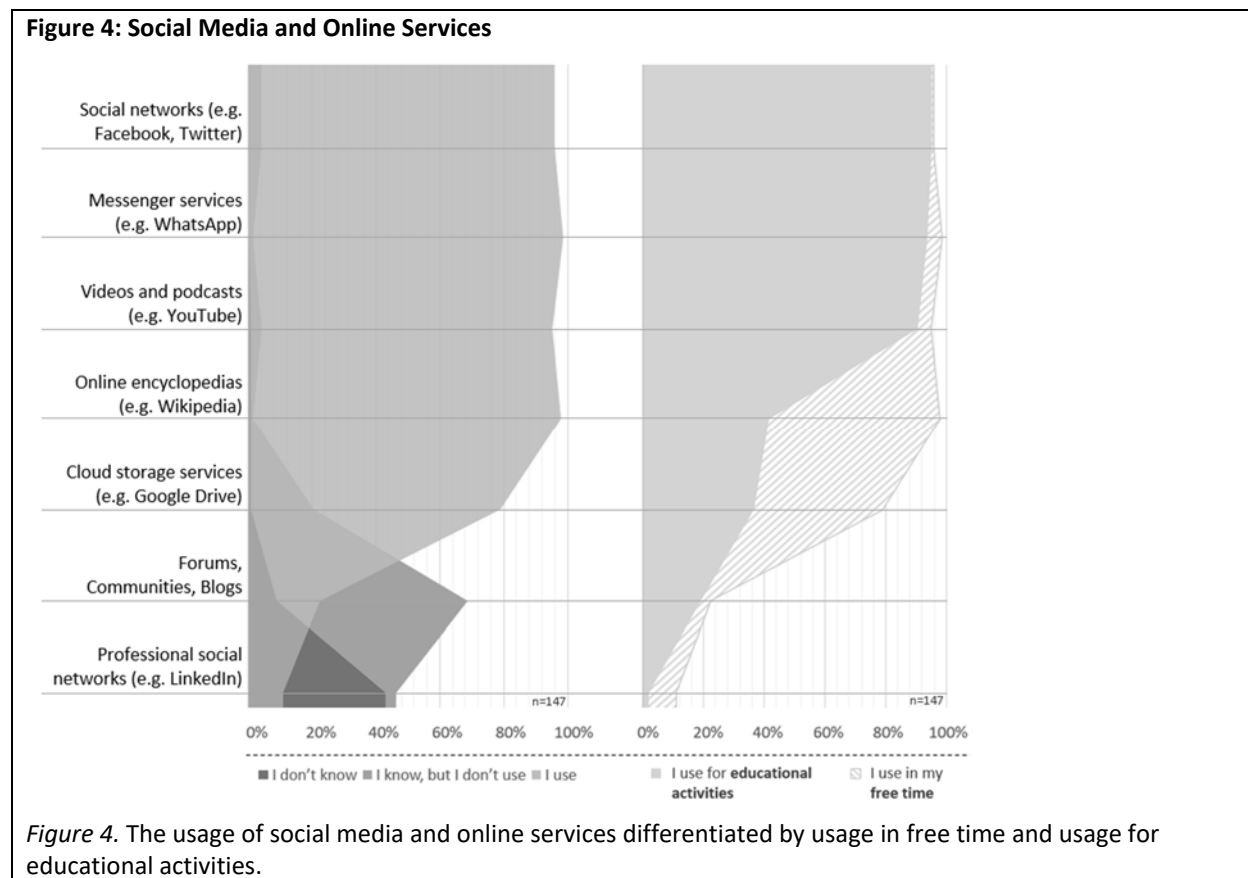
The fact that digital devices are already widespread among young people is shown above all by the fact that of eight devices given for selection in the survey[3], nobody indicated owning only one device. Of the 153 respondents, 26 people own five devices or more. The average number of owned devices is 3.4. In general, the trend is towards portable devices is apparent, as can be seen for example by the fact that just 56% of the pupils own a desktop computer, which almost all use for educational activities. In comparison, 87% own a portable laptop or notebook, of which 76% use it for school purposes and 65% use the device in their free time (see Figure 3).

Figure 4 shows how respondents use their devices and which social media or online services they use. Social media, messenger services, but also videos and podcasts are used by the respondents both in their free time and for educational purposes (approximately 90%). Online encyclopedias like Wikipedia are also used by almost all participants (98%) in their free time, but less than half (42%) use it for learning activities. This requires educational institutions to follow the trend in a way that the social channels that are mainly used by the target group are provided with valid information.

Cloud services, forums and online-communities, as well as professional social networks are currently less popular, especially for educational activities. Particularly surprising is the result that 42% do not even know about professional social networks like *LinkedIn* or *XING*, while almost half of the participants (46%) know them, but do not use them. This circumstance seems to hold great potential, since in a
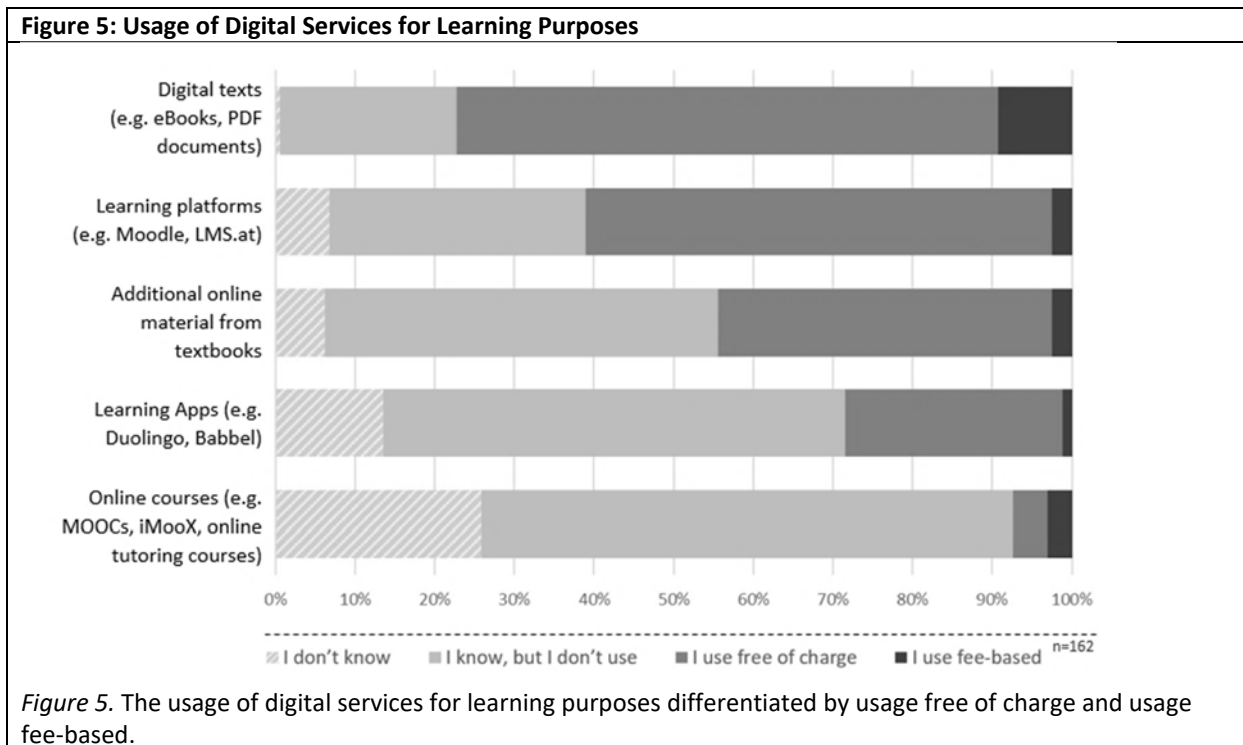
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[3] The following devices were available for selection in the pretest: Smartphone (with Internet access), Mobile phone (without Internet access), Laptop/Notebook, PC (Desktop/Computer), Tablet, Portable Media Player (e.g. MP3-Player, iPod), E-Book-Reader, Wearables (e.g. Smartwatch).

constantly changing labor market, maintaining a presence on professional platforms could not only improve employability, but might also be a prerequisite for participating in the labor market in a digital future (Lupton, Oddone & Dreamson, 2019).

Figure 4: Social Media and Online Services

Figure 4. The usage of social media and online services differentiated by usage in free time and usage for educational activities.

Concerning digital services that can be used for learning purposes, pupils were asked to state which online services they know and which of them they use (free of charge and/or fee-based) (see Figure 5). More than three-quarters of the pupils surveyed (77%) use a service to retrieve text documents (e.g. PDF documents). This service is predominantly used free of charge (68%), while only a minority (9%) pay for this kind of service. Learning platforms like *Moodle* or *LMS.at* are used by 61% of the pupils. Although the majority of the respondents are aware of learning apps (58%), only 28% use them.

A surprising finding concerns online courses like *MOOCs* or *iMooX*. By now only 7% of those surveyed use such services, while 67% have already heard of them, but do not use them. The remaining 26% do not even know about such online courses; therefore, higher education institutions might do well in promoting their *MOOCs* and online tutoring courses and make these services better known. Furthermore, it might be beneficial for future technology-supported teaching and learning settings to perfectly tailor the online course offerings to students. Also learning platforms such as *Moodle* or *LMS.at* could be used to a greater extent.

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Figure 5: Usage of Digital Services for Learning Purposes

Figure 5. The usage of digital services for learning purposes differentiated by usage free of charge and usage fee-based.

Going into First Year: Expectations vs. Reality

Teaching in higher education institutions is still conducted in a rather traditional way. Although the majority of courses are already supplemented by online materials, the potential of online teaching is far from being exploited and is only gradually finding its way into educational institutions. For example, successful use of blended learning can combine the advantages of online and face-to-face teaching and thus offer an optimal setting for learners. Formats such as these or similar, are precisely what the surveyed pupils want.

Most of the ongoing freshmen (83%) expect course instructors to often try something with new media. A study on vocational training in the digital age reaches a similar finding. 85% of the respondents want their instructors to try out something new with digital learning media and 93% prefer a mixture of analog and digital instructions (Schmid, Goertz & Behrens, 2016). The majority (90%) also want digital devices to be allowed for studying purposes during class time. On the other hand, the survey has shown that students do care about the content of a course, since 71% of them think that lecturers should focus on their expertise before considering which digital media to use. Good teaching is a sensible combination of media and didactics.

Figure 6 shows a list of items addressing the expectations pupils have of teaching and learning in higher education. The items have been measured on a 4-point Likert scale, whereby 1 stands for "strongly

agree" and 4 for "strongly disagree". In the figure the items are sorted by mean, whereby low mean values indicate approval.

Figure 6: Expectations of Teaching and Learning in Higher Education

Figure 6. Items measuring the pupils' expectations of teaching and learning in higher education sorted by mean values
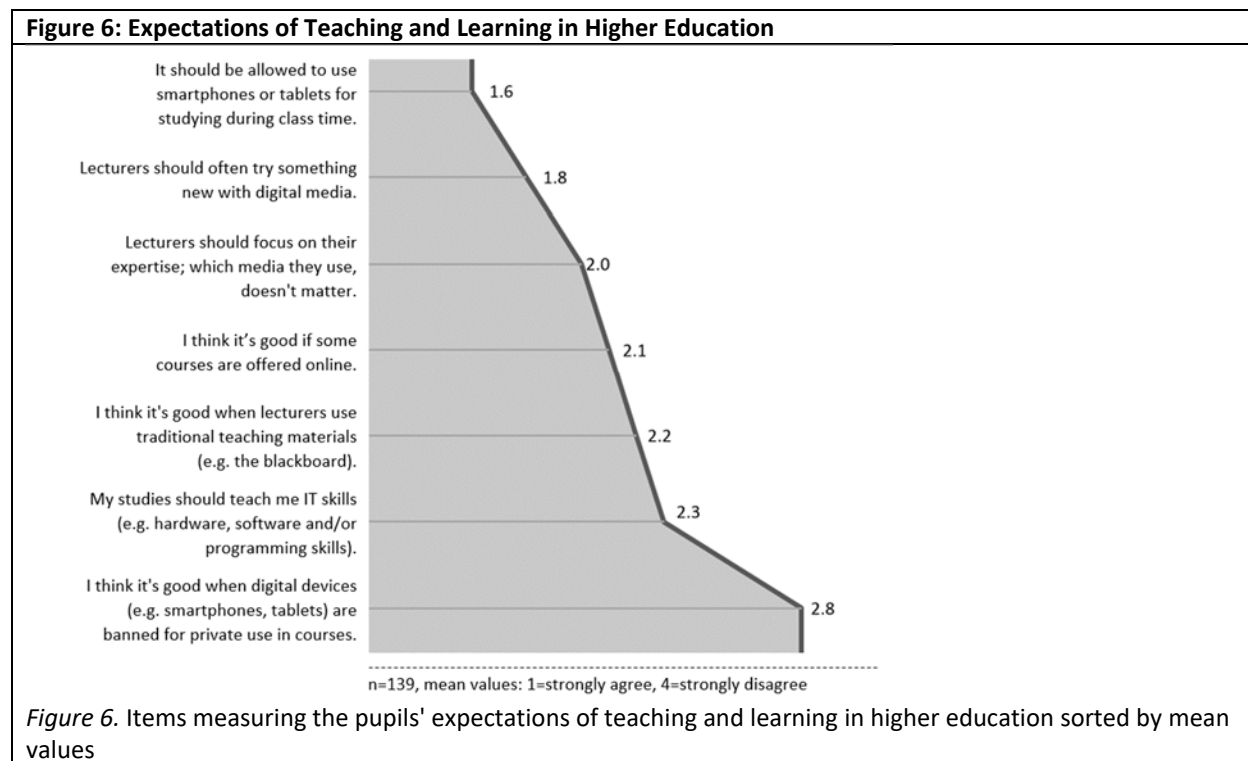
Discussion and Future Work

Digitalization – or more differentiated – digital transformation leads to new questions and challenges for higher education institutions. In some cases, the current questions are not completely new, but these questions need new answers. In addition to changing framework conditions and in the interest of providing an environment for teaching and learning at higher education institutions, it is also important to perceive the changed competence requirements of graduates. Learners should be provided with a range of learning processes to help them develop and further promote the required competencies. In order to stimulate the promotion of necessary competencies for a digital world, it is important to know the entry qualifications of first-semester students by getting an overview of their digital competencies. This is done in the above described DiKoS-project at the University of Graz.

Within this paper, the authors specifically focused on the pretest results of the DiKoS-project. Based on the pretest data, results were first presented in this article. A major limitation of the study is that the size of the pretest sample does not yet allow generalizable statements to be made about how the design of teaching sessions might be structured in concrete terms based upon the digital competencies of the students surveyed. Nevertheless, initial starting points for the design of higher education teaching can already be identified. For instance, the current results have shown, that educational institutions could focus much more on the use of devices for educational purposes, by making use of targeted applications

or tools. Further findings suggest that online courses like MOOCs, tutoring classes, as well as professional online platforms, should be better promoted by higher education institutions. Based on the digital competencies that first-semester students bring with them, the design of adequate teaching processes can be addressed. Furthermore, one of the aforementioned challenges for designing teaching processes in a digitized world is to rethink present educational content and develop new curricula. Since the discussion regarding the design of teaching due to the changed framework conditions caused by digital transformation usually only takes place on a media and methodological didactic discussion, there is a great need for research in the field of current and future educational goals and contents. One such study is underway as a doctoral project at the University of Graz. The aim of the doctoral thesis is to identify necessary new educational goals and content for curricula development in economic and business education.

With regard to the students, a database is needed that allows generalizable statements to be made about their digital competencies. The already mentioned DiKoS-project of the University of Graz has created such a database with 4.676 surveyed first-year students of the winter semester 2019/2020. Based on this data, it will be possible to make generalizable statements about the degree of digitization among Austrian students. Furthermore, the data can be used to derive recommendations for the development of new technology-supported teaching and learning offerings. These are more important than ever with regard to the current COVID-19 situation. The spread of the corona virus is currently forcing universities to very quickly switch to online and distance learning with an extremely short lead time. In order to draw the best lessons from this transformation process, accompanying empirical studies and comprehensive reports from lecturers and students on their experiences with online teaching and learning are required. Measuring the digital competencies of lecturers and students can also make valuable contributions here, in order to provide empirically sound knowledge and recommendations for action for the further development of online teaching and learning.

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